REMARKS

Claims 1, 5, 6 and 11 are proposed to be amended herein. Claims 1-11 are presently pending in the above-identified application.

Rejection of Claims 1-4 and 6-9 under 35 USC § 102

The Office Action rejected originally filed claims 1-4 and 6-9 under 35 USC § 102(e) as being anticipated by U.S. Patent Application Publication No. 2004/0069195 of D. Goldstein (hereinafter "Goldstein"). The Office Action further rejected originally filed claims 1, 5, 6, 10 and 11 as being anticipated by U.S. Patent No. 5,934,622 issued to J. Meng (hereinafter "Meng"). Applicants have amended the claims herein to more particularly claim the various aspects of the invention, and respectfully submit that each of the currently pending claims is patentably distinct from Goldstein and Meng for at least the reasons set forth hereinbelow.

More particularly, the various aspects of the present invention are directed to a method and apparatus wherein nanostructures or microstructures are disposed on a surface of a body (such as a submersible vehicle) that is adapted to move through a fluid, such as water. The nanostructures or microstructures are disposed on the surface in a way such that the contact between the surface and the fluid is reduced and, correspondingly, the friction between the surface and the fluid is reduced (see, e.g., Applicants' Specification, page 2, lines 1-9). Importantly, the claimed "nanostructure(s)", in accordance with the invention, is a predefined structure having at least one dimension of less than one micrometer and the "microstructure(s)" is a predefined structure having at least one dimension of less than one millimeter. (see, e.g., Applicants' Specification, page 10, lines 16-20). Further, importantly, the friction control (i.e., "skin" drag reduction) between the surface and the fluid is controlled (1) as a function of a surface energy of the nanostructures or microstructures (see, e.g., Applicants' Specification page 2, lines 13-15; page 7, lines 1-27; page 8, line 15 through page 9, line 27; and page 10, line through page 11, line 17); and (2) independent of a flow state (i.e., laminar flow or turbulent flow) of the fluid.

In accordance with a further aspect of Applicants' invention, as claimed in the amended claims herein, fluid is caused to at least partially penetrate the nanostructures or microstructures on the surface of the body in order to selectively create greater friction in a desired location of the surface. Advantageously, such selective penetration, in accordance with the invention (as claimed in amended claims 5 and 11), may be used to create drag that alters the direction or speed of travel of the body through the fluid (see, e.g., Applicants' Specification, page 2, lines 17-22; and page 12, line 27 through page 13, line 11).

It is at least these above-described aspects of Applicants' invention that stand in contrast to the cited prior art.

Applicants have amended the originally filed independent claims to more particularly claim the above-described aspects of the invention. For example, amended independent claims 1 recites:

> "An apparatus comprising:
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> a surface on a body, said body adapted to move through a fluid; and
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> a plurality of nanostructures or microstructures, each nanostructure of said plurality of nanostructures having at least one dimension of less than one micrometer, and each microstructure of said plurality of microstructures having at least one dimension which is less than one millimeter, disposed in a pattern on said surface in a way such that friction between said surface and said fluid is controlled as a function of a surface energy of said nanostructures or microstructures and independent of a flow state of said fluid." (Emphasis added by Applicants)

Each of the currently pending independent claims has been amended in a similar fashion as the above-referenced amended claim 1 to contain similar limitations.

Applicants appreciated how the Examiner may have found certain similarities between Goldstein and Applicants' claimed invention (as set forth in the originally filed claims) as each are generally related to reducing friction between a fluid and a body moving through such fluid. Indeed, Applicants' Specification (e.g., at page 1, lines 11-27; and page 4, lines 1-22) described the general problem in some detail. However,

Applicants respectfully submit that the pending claims, as amended herein, are patentably distinct from Goldstein and Meng, as will now be discussed.

More particularly, Applicants' understand Goldstein to teach viscous drag reduction technique which utilizes trapped bubbles in small closely-spaced cavities (or holes) in a submerged surface to reduce the viscous drag on the surface (see, e.g., Goldstein, page 1, paragraph [0009]). Importantly, however, Goldstein's technique, as pointed out in the Office Action (see, Office Action, page 2) the cavities (or holes) are in the range of 10 to 100 to 10000 holes per square centimeter. Further, Goldstein, at page 1, paragraph [0033] only intimates of holes "...of a size ~ 1mm will likely be necessary under the most turbulent, high-shear, applications...". Further, in accordance with Applicants' understanding, critical to Goldstein's technique is the reliance of backpressure of the trapped gas in the closely-spaced cavities to sustain the liquid/air interface (see, e.g., Goldstein, paragraph [0009]).

In rejecting the originally filed claims 1-4 and 6-9, the Office Action relies on the above-described Goldstein passage. However, such passage from Goldstein does not anticipate Applicants claimed nanostructure(s) having at least one dimension of less than one micrometer or the microstructure(s) having at least one dimension of less than one millimeter. Further, in accordance with the amended claims herein, the claimed friction control between the surface and the fluid is controlled (1) as a function of a surface energy of the nanostructures or microstructures; and (2) independent of a flow state (i.e., laminar flow or turbulent flow) of the fluid. As such, Applicants' claimed friction control is delivered in a completely different manner which is neither taught or suggested by Goldstein.

As to Meng, Applicant respectfully submit that such reference is primarily directed at a technique for suppression of turbulent drag and affecting a turbulent envelope (see, e.g., column 5, lines 36-38) and is not particularly relevant to the present invention. That is, in contrast to Meng, as discussed above, Applicants' claimed invention (in accordance with amended claims herein) is directed to "skin" drag reduction without concern with (or influence of) turbulent drag or turbulent envelope. Applicants' drag reduction is achieved through the utilization of nanostructures or microstructures disposed on a surface in a way such that the contact between the surface and a fluid is

reduced and the claimed friction control between the surface and the fluid is controlled (1) as a function of a surface energy of the nanostructures or microstructures; and (2) independent of a flow state (i.e., laminar flow or turbulent flow) of the fluid, none of these aspects of the claimed invention is taught or suggested by Meng.

Further, with respect to Applicants' amended claims 5 and 11, these claims are directed to a further aspect of the invention wherein the fluid is caused to penetrate the pattern of nanostructures or microstructures at a select location on the surface such that the penetration of the fluid at the select location alters a direction or a speed of the vehicle in the fluid (see, e.g., Applicants' Specification, page 2, lines 20-22; and page 12, line 27 through page 13, line 8). Neither Goldstein or Meng teach or suggest this further aspect of Applicants' claimed invention. The cited portion of Goldstein (page 3, paragraph [0036]) is directed to utilizing a voltage to a conductive metal layer in Goldstein's article to "restore" the so-called "bubble interface" which may be lost over time in Goldstein's cavities due to gas diffusion into the water, Goldstein's teaching has nothing to do with affecting the speed or direction of an object as it moves through fluid. Further the cited portion of Meng (column 8) is directed to affecting the turbulent envelope/turbulent flow (Meng's primary directive, as discussed above) and not utilizing a pattern of nanostructures or microstructures at a select location on the surface such that the penetration of the fluid at the select location alters a direction or a speed of the vehicle in the fluid, as claimed by Applicants.

Applicants respectfully submit that neither Goldstein or Meng teach or suggest the notion where fluid is caused to at least partially penetrate the nanostructures or microstructures on the surface of the body in order to selectively create greater friction in a desired location of the surface thereby creating drag that alters the speed or direction of a body itself as it is propelled through the fluid, as claimed by Applicants in the amended claims herein.

In view of the foregoing, Applicants respectfully submit that each of the currently pending claims, as amended, are patentably distinct over Goldstein and Meng, and, therefore, respectfully submit that each of the currently pending claims in the application is in condition for allowance and reconsideration is requested. Favorable action is respectfully requested.

Should the Examiner believe anything further is desirable in order to place the application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number listed below.

Respectfully submitted,

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